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5′-nucleotidase Activity in the Malpighian Tubule Cells of *Pericallia ricini* (Arctiidae: Lepidoptera)

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The 5′-nucleotidase activity has been studied for the first time in the Malpighian tubule cells of Indian moth, *P. ricini* during larval-pupal-adult transformation. Enzyme activity varies significantly during different phases of cellular activity and there is every possibility of the active involvement of 5′-nucleotidase in the functional stage of the cells.

Key Words: *Pericallia ricini*, **5′-nucleotidase activity, Malpighian tubule, Larval-pupal-adult transformation, Cellular activity**

Introduction

The structure and the activity of Malpighian tubule cells during different stages of development is a subject of controversy (Srivastava & Khare 1966, Waku 1974, Luiza *et al.* 1978, Ryerse 1978 and Le Garff 1979) . There has been very little work on the cytochemistry of these cells, more so during development. Therefore, the present investigation was undertaken to study the events occurring at the chemical level, representing histological and functional variations related with 5′-nucleotidase activity in the Malpighian tubule cells of Lepidopteran pest, *P. ricini*, during larval-pupal-adult transformation.

Materials and Methods

Malpighian tubules were dissected out from *P. ricini* at different stages of development (larvae, pupae and adults) and sectioned 6–8 mμ thick, with Cryostat. Calcium method (Pearse 1968) was employed to detect 5′-nucleotidase activity in the cells using a substrate (adenosine-5-phosphate) and omitting it from the incubating mixture in the controls.

Observations

An intense enzyme activity (at *p*H 6.8) is observed in the brush border of MT cells of the larval and the prepupal stage of *P. ricini* (figure 1). The 5′-nase activity in the brush border gradually declines with the onset of pupation and finally disappears when the brush border becomes indistinct.. Enzyme activity in the MT

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cells of 1-day-old pupa shows that appreciable amount of reaction product is formed in the entire cytoplasm of the cells (figure 2).

In the MT cells of 5-day-old pupa of *P. ricini* there is a marked increase in the enzymatic activity in all the cells around the lumen of the tubule (figure 3). The localization of enzyme does not show any intracellular variation. 5'-nase activity comparatively decreases in the late pupa. In the cell the enzyme is distributed randomly while the luminal and peripheral regions are particularly rich in enzyme (figure 4).

In the newly-emerged adult and in those after 24 hr of emergence, the 5'-nase activity in the MT cells is appreciably reduced. However, the brush border circumventing the lumen of the tubule shows dense deposition of reaction product, formed subsequent to the treatment of cells for the detection of 5'-nase activity (figure 5).

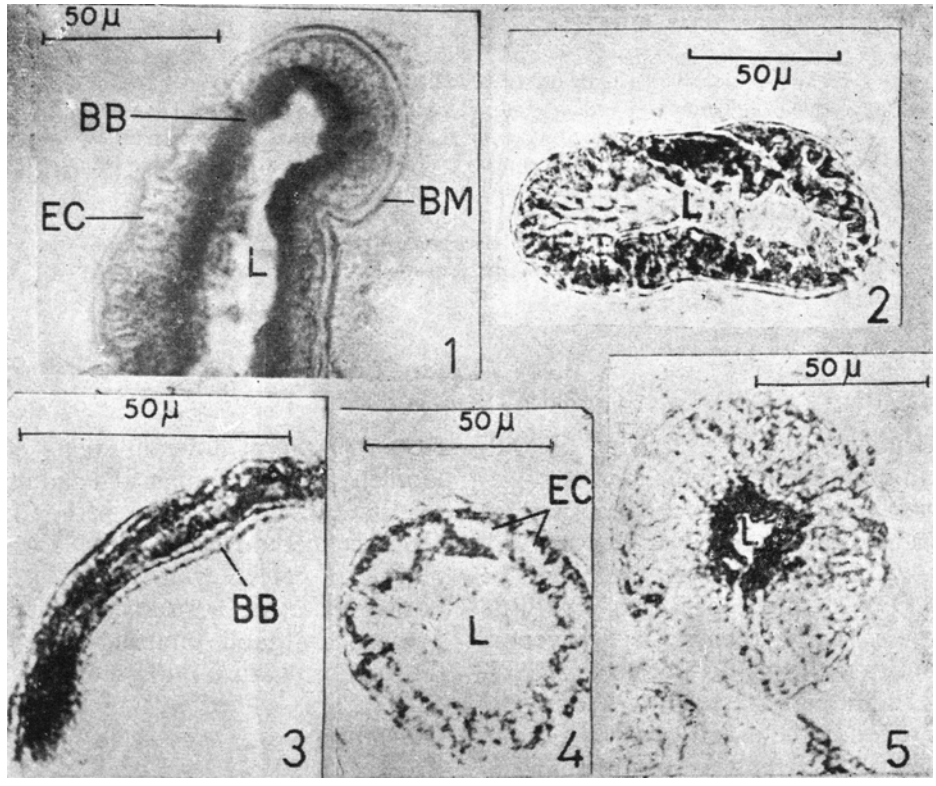

Figure 1–5 (1) M T cells of fifth instar larva of *P. ricini* showing 5'-nase activity chiefly confined to brush border ; (2) 5'-nase activity in the MT cells of 1-day-old pupa. Reaction product randomly distributed in the cytoplasm. Brush border indistinct; (3) A part of the Malpighian tubule in C.S. of 5-day-old pupa of *P. ricini* (5'-nase activity markedly increased); (4) M T cells of 9-day-old pupa of *P. ricini* showing reduced enzymatic activity; (5) 5'-nase activity in the M T cells of 1-day-old adult of *P. ricini* (Enzymatic reaction product is formed mainly in the brush border circumventing the lumen of the gland). *5'-nase*, 5'-nucleotidase; *BM*, Basement membrane; *BB*, Brush border; *EC*, Excretory cell; *MT*, Malpighian tubule; *L*, Lumen

Discussion

Of late, the recognition of 5'-nase as a membrane-associated enzyme in the tissues of different groups of animals has been corroborated by several investigators (Sprey 1971, Little & Widnell 1975, Dabholkar & Tewari 1978, Klaushoffer & Mayersbach 1979 and Kent *et al.* 1979). The high level of enzyme activity in the brush border of the MT cells of *Pericallia ricini* in the larval and the pre-pupal period and its absence in the other parts of the excretory cells, have been demonstrated by the authors in the light of the pesent work. The enzyme activity which varies considerably during development, growth and degeneration is related to energy metabolism and transport in the cells during these phases (Kent *et al.* 1979 and Kaltenbach *et al.* 1979). Our observations on MT cells of *P. ricini* are in agreement with those of above workers to a large extent. The intensely enzyme-positive brush border, in the larval and the pre-pupal stages shows no reaction in the early-pupal period. The enzymatic activity is not confined to specific sites in the cytoplasm, but spreads deeper in the cells. In the mid-pupal period (4–6 days) 5'-nase activity increases dramatically in the excretory cells, but again the brush border is not clear and enzyme activity is also not demonstrable in this region. Subsequently, in the late pupal stage the enzyme activity decreases appreciably in the MT cells. It appears that a spurt in the 5'-nucleotidase activity in mid-pupal and its sharp fall in the late pupal stage is related with some important chemical reaction occurring in the MT cells during this period of development in association with certain events not recognisable morphologically but manifested in the light of high metabolic activity and dramatic decline thereafter.

Itoh and Tsushima (1972) obtained a correlation between 5'-nucleotidase activity and uric acid concentration in the liver of the chick. Anstee *et al.* (1979) emphasized on the coupling of active transport, $Na^+ — K^+$ - activated enzyme activity and respiration in the MT cells of *Locusta* during fluid and cation secretion. Therefore, 5'-nase activity in larval-pupal-adult transformation may be related with the excretory activity of the MT cells.

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